*Zootaxa* 4750 (4): 577–584
https://www.mapress.com/j/zt/


# Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

https://doi.org/10.11646/zootaxa.4750.4.8
http://zoobank.org/urn:lsid:zoobank.org:pub:CD33E4BC-58FF-4EBC-B446-B00770861D06

## *Archophileurus spinosus* Dechambre, 2006 (Coleoptera: Scarabaeidae: Dynastinae), a new exotic scarab possibly acclimatized in Italy, with a compilation of exotic Scarabaeidae found in Europe

ENRICO RUZZIER[1,2], FILIPPO TOMASI[2], MATTIA POSO[3] & ISABEL MARTINEZ-SAÑUDO[1]
[1]*Department of Agronomy, Food, Natural Resources, Animals and the Environment (DAFNAE), University of Padova, Viale dell'UniversitaÌ 16, Legnaro, 35020 Padova, Italy. E-mail: enrico.ruzzier@phd.unipd.it*
[2]*World Biodiversity Association Onlus c/o Museo Civico di Storia Naturale, Lungadige Porta Vittoria 9, Verona, Italy. E-mail: research@biodiversityassociation.org*
[3]*Museo di Storia Naturale del Salento, S.P. Calimera-Borgagne, km 1, I-73021 Calimera, Italy. E-mail: posomattia@gmail.com*

### Abstract

*Archophileurus spinosus* Dechambre, 2006, a South American Scarabaeidae (Coleoptera: Scarabaeidae: Dynastinae: Phileurini) is recorded for the first time in Europe (Apulia, Italy). This species, which may have colonized the Italian peninsula in recent past and that could still be in the acclimatization phase, represents the first record of tribe Phileurini in Europe and the second case worldwide of interception of this genus outside its area of origin. After a brief presentation of the site and collecting conditions of the specimens, we discuss the possible threats for local biodiversity and agriculture that the establishment of *A. spinosus* could cause.

**Key words:** Alien, Coleoptera, Europe, exotic, globalization, IAS, Scarabaeoidea, threat

### Introduction

International trade is the primary cause of introduction and spreading of invasive alien species globally. Invasive alien species often constitute a serious threat for ecosystem balance, biodiversity conservation and cause relevant economic damage to human activities (Kenis & Branco 2010; Pyšek & Richardson 2010; Cameron *et al*. 2016); consequently, allochthonous species monitoring and management are among the most challenging tasks to accomplish nowadays. Early detection plays a central role in the control of invasive alien species, especially those that escape the surveillance implemented at the most common points of entry, such as ports and airports (Liebhold & Tobin 2008; Hulme 2009; Poland & Rassati 2019). Exotic species spreading is directly linked to ecosystem degradation in many parts of the world, including the Mediterranean-climate zones: the Mediterranean basin in particular is one of the biodiversity hotspots most at risk due to its pivotal role in world trade (Katsanevakis *et al.* 2014).

Scarabaeidae are a large and extremely diverse family of Coleoptera capable to successfully adapt to the majority of ecological niches. Thanks to this diversity in adaptations, biology and size, representatives of this group have often been introduced actively or passively by man all over the world (*e.g.* Barbero & Loìpez-Guerrero 1992; Dymock 1993; Jameson *et al*. 2009). Some of these species are now common and widely recognized pests (*e.g.* Abdallah *et al.* 2013; Allsopp *et al*., 2018). This dispersal and establishing process seems to be favored by the progressive global warming, especially in temperate climates. In Europe, more than fifteen exotic scarab species have been recorded so far (Table 1).

In the present paper we report the first record of *Archophileurus spinosus* Dechambre, 2006 (Scarabaeidae: Dynastinae: Phileurini) in Europe, based on four specimens collected between 2017 and 2019 in southern Italy. Furthermore, we discuss the possible introduction pathway of this scarab, trying to define the potential risks that a stable population of this species could cause to the environment and the agricultural activities.

*Accepted by A. Bezděk: 18 Feb. 2020; published: 13 Mar. 2020*

**TABLE 1.** List of exotic Scarabaeidae intercepted or established in Europe

| Species | Subfamily | Origin | Record | References |
|---|---|---|---|---|
| *Acrossidius tasmaniae* (Hope, 1847) | Aphodiinae | Oceania | Italy | Mazza *et al*. 2014 |
| *Aphodius gracilis* Boheman, 1857 | Aphodiinae | Africa | Portugal-Azores | Denux & Zagatti 2010 |
| *Ataenius brevicollis* (Wollaston, 1854) | Aphodiinae | Azores | Portugal-Azores | Bezděk 2016 |
| *Ataenius gracilis* (Melsheimer, 1844) | Aphodiinae | South America | Portugal-Azores | Bezděk 2016 |
| *Ataenius picinus* Harold, 1867 (species identity requires confirmation, G.M. Carpaneto, personal communication) | Aphodiinae | South America | France, Italy | Inghilesi *et al*. 2011; Lemaire & Raffaldi 2014; Leo *et al*. 2015; Bezděk 2016 |
| *Ataenius simplicipes* Mulsant & Rey, 1870 | Aphodiinae | South America | France | Bezděk 2016 |
| *Ataenius spretulus* (Haldeman, 1848) | Aphodiinae | North America | Portugal | Branco 2011; Leo *et al*. 2015; Bezděk 2016 |
| *Parataenius simulator* (Harold, 1868) | Aphodiinae | South America | Portugal | Inghilesi *et al*. 2011; Bezděk 2016 |
| *Saprosites mendax* (Blackburn, 1892) | Aphodiinae | Australasia | Great Britain | Angus *et al.* 2003; Denux & Zagatti 2010; Branco 2011; Inghilesi *et al*. 2011; Bezděk 2016 |
| *Saprosides natalensis* (Péringuey, 1901) | Aphodiinae | Africa | Great Britain | Angus *et al.* 2003; Branco 2011; Bezděk 2016 |
| *Saprosides peregrinus* Redtenbacher, 1858 | Aphodiinae | Central-South America | Austria | Branco 2011; Bezděk 2016 |
| *Tesarius caelatus* (LeConte, 1857) | Aphodiinae | North America | Great Britain | Johnson 1975; Rakovič *et al*. 2016 |
| *Tesarius mcclayi* (Cartwright, 1955) | Aphodiinae | North America | Great Britain | Rakovič *et al*. 2016 |
| *Chiron cylindrus* Fabricius, 1798 | Chironinae | Asia | France, Italy | Král & Bezděk 2016 |
| *Augosoma centaurus* (Fabricius, 1775) | Dynastinae | Africa | Italy | Ratti 2007b |
| *Pentodon algerinus dispar* Baudi, 1870 | Dynastinae | Middle East | Germany | Baufeld & Schrader 2017 |
| *Pendodon variolopunctatus deserti* (Heyden, 1900) | Dynastinae | North Africa and Middle East | Bosnia and Herzegovina | Krell & Bezděk 2016 |
| *Temnorhynchus baal* Reiche & Saulcy, 1856 | Dynastinae | South-East Europe | Sweden | Forshage & Krell 2016 |
| *Tomarus villosus* (Burmeister, 1847) | Dynastinae | South America | Sweden | Forshage & Krell 2016 |
| *Liogenys excisa* (Reitter, 1918) | Melolonthinae | South America | Italy | Sanmartín & Martín-Piera 2003; Ratti 2007a |
| *Serica intermixta* Blatchley, 1910 | Melolonthinae | North America | Germany | Ahrens & Kless 2001; Ahrens & Bezděk 2016 |
| *Euonticellus intermedius* (Reiche, 1850) | Scarabaeinae | Africa | Italy | Ratti 2007a |
| *Anomala variicolor* (Gyllenhall, 1817) | Rutelinae | Southeast Asia | Italy | Paulian & Baraud 1982 |
| *Popillia japonica* Newman, 1841 | Rutelinae | Asia | Italy, Switzerland, Germany, Portugal-Azores | Urban, 2018; EPPO 2019; Urban *et al*. 2019 |

## Materials and methods

The four specimens (see Material examined for details) of *A. spinosus* studied come from Serrano, a village in the province of Lecce (Apulia, Italy). The insects were apparently attracted by the lights used to illuminate monuments and sports facilities. The female was kept alive in captivity to assess whether it was fertile and capable to lay eggs. At the time of drafting this article and before submission, the female was able to lay two eggs, none of which has hatched yet. Species identification is based on the single male available (Fig. 1) using the keys provided by Endrődi (1977) and Di Iorio *et al*. (2017). Molecular analyses were conducted on the two last specimens collected. The DNA was extracted from each individual separately using the Qiagen DNeasy Blood & Tissue Kit (Qiagen, Valencia, CA, USA) following the manufacturer's instructions. A region of mitochondrial DNA, corresponding to a fragment of the COI gene, was amplified using the universal primers LCO-1490/HCO-2198 (Folmer *et al.* 1994). Amplifications were performed in 20 µl reactions (1 × polymerase chain reaction (PCR) Go Taq Flexi buffer—Promega, 2.5 mM MgCl2, 0.1 mM dNTPs, 0.5 µM for each primer, 0.5 U of Taq polymerase—Promega, 2 µl DNA template). Thermal cycling conditions were 5 min at 96°C followed by four cycles of 96°C for 1 min, 48°C for 1 min, and 72°C for 1 min, and other 35 cycles of 96°C for 1 min, 50°C for 1 min, and 72°C for 1 min, with a final extension of 72°C for 5 min. PCR products were purified using Exonuclease and Antarctic Phosphatase (GE Healthcare) and sequenced at the BMR Genomics Service (Padova, Italy). Sequences were edited and aligned using MEGA X (Kumar 2018) and subsequently, translated with Transeq (EMBOSS: http://www.ebi.ac.uk/Tools/emboss/transeq/index.html) to exclude the presence of stop codons in the coding region. A GenBank BLAST analysis of the sequences obtained was run through the NCBI website (http://www.ncbi.nlm.nih.gov) and the integrated bioinformatics platform Barcode of Life Data (BOLD) System database (http://www.barcodinglife.org) was used to assess the identity of the sequences.

## *Archophileurus spinosus* Dechambre, 2006

**Material examined.** Italy, Apulia: Serrano, 02. viii. 2017, 40°11'06.5"N 18°21'02.3"E, F. Tomasi lgt., dead female; Serrano, 03. vii. 2019, 40°10'58.5"N 18°21'15.5"E, F. Tomasi lgt., dead male; Serrano, 05. vii. 2019, 40°10'58.7"N 18°21'08.5"E, F. Tomasi lgt., live female; Serrano, 02. viii. 2019, 40°11'02.2"N 18°21'04.4"E, F. Tomasi lgt., dead female.

All specimens are deposited in the personal collection of Filippo Tomasi (Serrano, Italy).

### Systematics, biology and distribution

*Archophileurus* Kolbe, 1910 includes more than 30 described species (Di Iorio *et al*. 2017) and it is widely distributed throughout the entire New World, from South United States (Texas) to the northern part of Argentina and Chile (Moron 1990; Di Iorio *et al*. 2017). The genus is morphologically homogenous, and species identification is possible with certainty almost exclusively on the basis of the examination of male genitalia. Females are particularly difficult to identify and, in many cases, undescribed. Very little is known about the biology of both adult and larvae of Phileurini, especially for *Archophileurus.* The larvae of this genus generally develop in rotten and decaying wood (Moron 2009) as well as termite nests (Vanin *et al*. 1983), while adults are predators of other beetle larvae, such as Tenebrionidae and Passalidae (Moron 2009). *Archophileurus* larvae, as member of the "white grubs" guild ("gusanos blancos"), are also reported as possible cause of damage on crops, wheat and *Citrus* sp. especially (Ritcher 1966; Alzugaray *et al*. 1999; Di Iorio 2004; Massaro 2010; Mondaca 2011); however, the true harmfulness of this genus is still to be clarified.

*Archophileurus spinosus* was originally described from Paraguay (Dechambre 2006) and subsequently recorded in Northern, Central and Eastern Argentina (Di Iorio *et al*. 2017); its biology and the larval morphology remain unknown. The only existing record of the accidental introduction of *Archophileurus* sp. outside its natural range refers to a unique case happened in the USA (Meissner *et al*. 2009). *Archophileurus* species, like many other Phileurini, seem to prefer tropical forests (Di Iorio *et al*. 2017) even if the genus successfully colonized also harsh and xeric environments (Moron 1990).

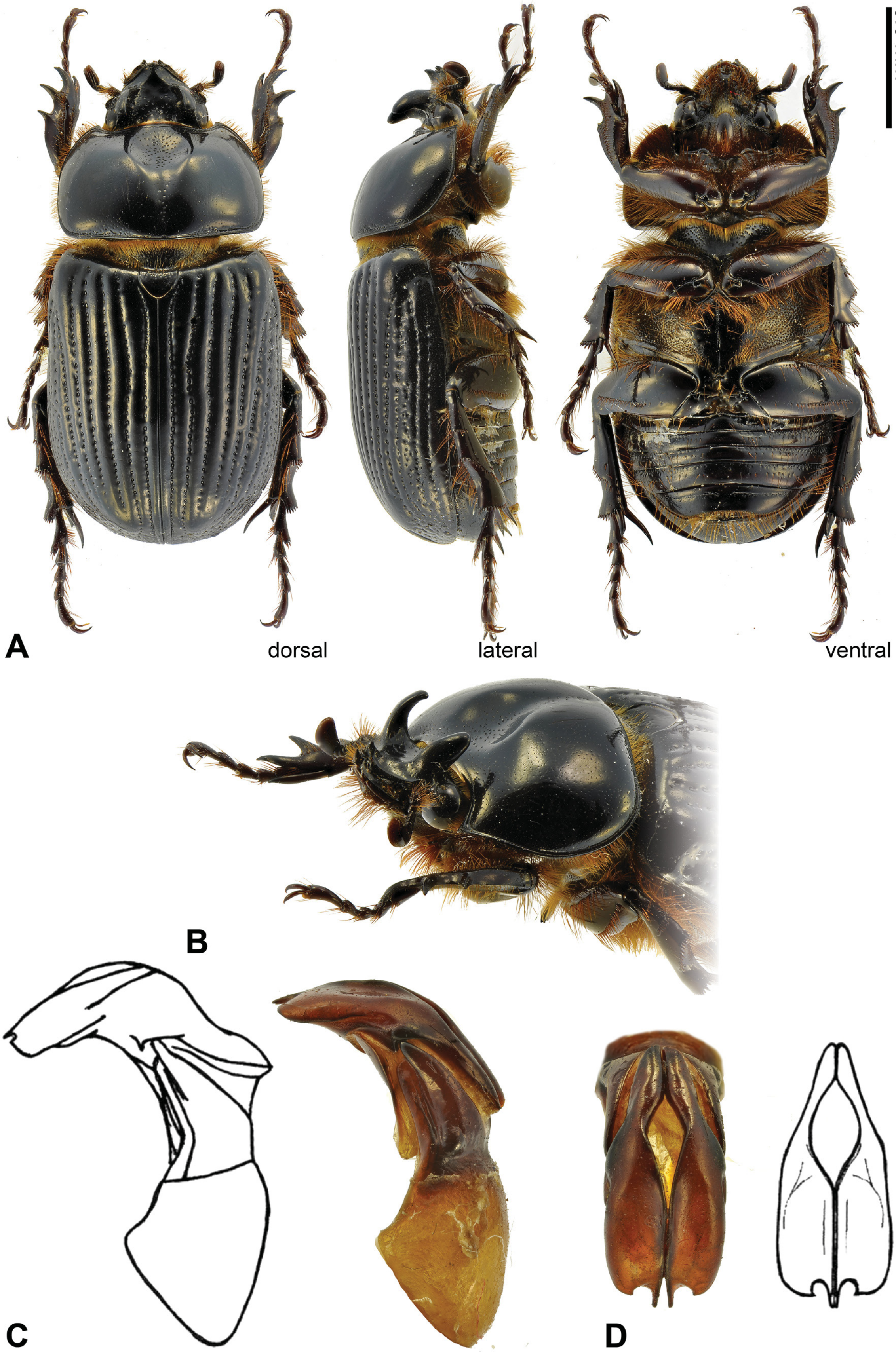


**FIGURE 1.** Male of *Archophileurus spinosus* Dechambre, 2006 from Serrano (Italy). A, dorsal, lateral and ventral views; B, dorso-lateral view of the head; C, aedeagus in lateral view and original drawing from Di Iorio *et al*. (2017); D, parameres in dorsal view and original drawing from Di Iorio *et al*. (2017).

**Diagnosis**

Adult male: *A. spinosus* closely resembles in general aspect and body size *Archophileurus chaconus* (Kolbe, 1910) and *Archophileurus vervex* (Burmeister, 1847) and the three species can be separated only on the base of parameres shape (see Di Iorio *et al*. 2017). Both females and larvae of the entire genus are not enough characterized to provide any discrimination character to separate one species from another; for this reason, DNA barcoding is certainly a tool of great help in the rapid identification of samples. A fragment of the mitochondrial gene COI (the barcode region) 631 bp long was obtained and sequences of the two individuals analyzed were identical; we here provide the COI sequence of *A. spinosus*: TGGAACATCACTAAGACTCTTAATCCGGGCTGAACTAGGAAACCCCGGATCCCTCATTGGA-GATGATCAAATTTATAACGTAATTGTTACAGCCCACGCTTTTATTATAATTTTCTTCATAGTTATACCAAT-TATAATTGGGGGATTCGGAAACTGACTAGTACCCCTAATACTAGGAGCCCCTGATATAGCATTCCCAC-GAATAAATAATATAAGATTTTGACTTTTACCCCCATCCCTAACGCTTCTTTTAGCTAGAAGAGTAG-TAGAAAATGGTGCAGGAACAGGCTGAACTGTCTATCCACCCTTATCAGCCAACATTGCTCATAGAG-GAGCCTCTGTAGACTTAGCAATTTTCAGATTACACCTCGCAGGAATCTCATCAATCTTGGGAGCTGTA-AATTTCATTACCACAGTAATCAACATACGATCAACAGGAATAACTTTTGACCGTATACCCCTATTCGCCTGATC-GGTAGTATTAACTGCAATCTTATTACTTCTATCACTACCAGTTCTTGCAGGAGCAATTACAATACTCCTA-ACAGATCGAAATATTAACACCTCTTTTTTTGATCCCGCAGGAGGTGGGGACCCAATCCTCTACCAA-CATTTATTTGATTTTTTGGTC.

A comparison with BoldSystem and NCBI databases showed a similarity of 86.6% and 83.7% respectively with *Allidiostoma* sp. (Allidiostomatinae) and surprisingly only an 83.96% similarity with *Archophileurus simplex* (Bates, 1888) (Costa Rica).

**Discussion**

Italy is a country at high risk of introduction of exotic species due to the important commercial and tourist traffic and to its particularly favorable climatic and environmental conditions (Jucker & Lupi 2011). For these reasons, the degree of attention towards exotic species remains particularly high. Every year new exotic beetles are intercepted in the main arrival points; however, these likely constitute only a limited fraction of the actual arrivals. It is interesting to note that most of the exotic species recently found in Italy have been captured in the natural environment already, and they probably have stable populations (Clark *et al*. 2014; Zappi 2014; Salvato & Uliana 2016; Toma *et al.* 2017; Guariento *et al*. 2019; Mola & Yoshida 2019; Forbicioni 2019; Ruzzier & Colla 2019). The presence of *Archophileuru spinosus* in Apulia, although totally unexpected, is perfectly in line with the aforementioned records: beetles that usually escape the main control procedures or that are not targeted by the most-used monitoring systems. This taxon despite having only recently been described and being known in a limited number of specimens, is apparently widely distributed in Argentina, Paraguay and potentially could occur in Uruguay and South Brazil (Di Iorio *et al*. 2017). *Archophileurus spinosus* seems to be rarer than the closely related *A. chaconus* and *A. vervex*, however its wide distribution has probably made it more predisposed to be transported outside its natural range. The scant information available about *A. spinosus* biology combined with the scarce data deriving from the place of its discovery therefore make it difficult to reconstruct the pathway of introduction of this species into the Italian territory, especially considering that Serrano is a village lacking any important industrial areas and being located far from international ports and airports. As a consequence, we can only hypothesize that this species may have been introduced at the larval stage in association with some commodities such as ornamental plants and/or soil for gardening, as it happened with many other Scarabaeoidea (Forshage & Krell 2016; Allsopp *et al*. 2018). The escape of some specimens from amateur breeding has to be discarded, as the species does not belong to those genera usually bred and traded; furthermore, almost nobody has ever tried rearing *Archophileurus* (Paschoal C. Grossi, personal communication). The limited data available on *Archophileurus* biology, both for adults and larvae, makes it difficult to estimate the possible impacts that this species may have on the local ecosystem and agriculture. Similarly to those of *A. vervex* or *A. chaconus*, the larvae of *A. spinosus* may cause damages to the roots of cultivated plants in the new environment of southern Italy. Furthermore, if the adults of this species were predators of larvae of other beetles, they could have an impact on the local fauna. In the area, *Phyllognathus excavatus* (Forster, 1771) and *Oryctes nasicornis* (Linnaeus, 1758) (Scarabaeidae: Dynastinae) are common (F. Tomasi, personal observation) and the larvae of the latter develop in numbers in the mulching of the olive groves. This type of environment could constitute, in

the absence of large hollow trees, the ideal reproduction site for *A. spinosus*; there the larvae would have a sufficient and stable substrate to develop while the adults could prey on the larvae of the other scarabs. Furthermore, given the predisposition of this genus to colonizing decaying trees and their cavities, a possible range expansion of this species on the Italian territory could put at great risk different groups of saproxylic beetles, some of which are already in conditions of serious threat (Audisio *et al*. 2014).

At the moment it is of primary interest to define whether a stable population of *Archophileurus spinosus* species exists and if this species is present in other localities. We believe it is necessary to investigate the origin of these specimens, confirm the presence of a stable population and eventually develop a prompt monitoring strategy so as to identify the possible effects that this taxon may have on the ecosystem and in agricultural systems. It is in fact in these early stages of invasion that containment and eradication plans are more likely to succeed. We also hope that DNA barcoding will be of help to research groups and phytosanitary institutes in identifying this species from the larval stages, so as to carry out control actions well before the appearance of adults.

## Acknowledgments

The authors thanks Maurizio Bollino (Lecce, Italy) for the photograph realization, Andrea Battisti and Davide Scaccini (DAFNAE, Università degli Studi di Padova, Italy), Carlo Legittimo (Museo di Storia Naturale di Trieste, Trieste, Italy), Alberto Ballerio (Brescia, Italy), Gastón Zubarán (INBIOTEC-CONICET, Buenos Aires, Argentina), Paschoal C. Grossi (Universidade Federal Rural de Pernambuco, Recife, Brasil) and the two referees Frank-Thorsten Krell (Denver Museum of Nature and Science, Denver, USA) and Antonio Rey (Genova, Italy) for their valuable comments.

## References

Abdallah, Z., Mezghani-Khemakhem, M., Bouktila, D., Makni, H. & Makni, M. (2013) Genetic variation and invasion pattern of the arabian rhinoceros beetle, *Oryctes agamemnon arabicus* (Burmeister) (Coleoptera: Scarabaeidae), in Tunisia, deduced from mitochondrial DNA Sequences. *African Entomology*, 21 (2), 362–367.
https://doi.org/10.4001/003.021.0201

Ahrens, D. & Bezděk, A. (2016) Sericini Kirby, 1837. *In*: Löbl, I. & Löbl, D. (Eds.), *Catalogue of Palaearctic Coleoptera. Vol. 3. Revised and Updated Edition. Scarabaeoidea—Scirtoidea—Dascilloidea—Buprestoidea—Byrrhoidea*. Brill, Leiden/Boston, pp. 281–321.

Ahrens, D. & Kless, J. (2001) Eine importierte nordamerikanische *Serica*-Art (Coleoptera, Scarabaeoidea, Sericini) in Baden-Württemberg. *Entomologische Zeitschrift*, 111 (5), 153–155.

Allsopp, P.G. & Hutchinson, P.M. (2018) The exotic Whitegrub *Plectris aliena* Chapin (Coleoptera: Scarabaeidae: Melolonthinae) is more widely distributed in Australia than previously thought. *The Australian Entomologist*, 45 (1), 1–6.

Alzugaray, R., Zerbio, M.S., Morelli, E., Castiglioni, E. & Ribeiro, A. (1999) Manejo de gusanos blancos en cultivos cerealeros en Uruguay. *In*: Vaz-de Mello, F.Z., Oliverira, L.J., Louzada, J.N.C., Salvadori, J.R. & Escobar, F. (Eds.), *Memorias de la IV reuniao latino-americana de scarabeidologia*. Universidade Federal de Viçosa, Viçosa, pp. 85–90.

Angus, R.B., Wilson, C.J., Mateě, J.F., Hammond, P.M. & Mann, D.J. (2003) *Saprosites mendax* (Blackburn) and *S. natalensis* (Peringuey) (Scarabaeoidea, Aphodiidae), two species introduced into Britain. *In*: Bowden, C.P. (Ed.), *Proceedings of the second pan-European conference on Saproxylic Beetles*. People's Trust for Endangered Species, London, pp. 72–76.

Arnone, M. (2010) Quinto contributo alla revisione della collezione coleotterologica di Enrico Ragusa: Scarabaeoidea. *Il Naturalista Siciliano*, 34, 61–172.

Audisio, P., Baviera, C., Carpaneto, G.M., Biscaccianti, a.B., Battistoni, A., Teofili, C. & Rondinini, C. (2014) *Lista rossa IUCN dei Coleotteri saproxilici italiani*. Comitato italiano IUCN e Ministero dell'ambiente e della tutela del territorio e del Mare, Roma, 133 pp.

Barbero, E. & Loìpez-Guerrero, Y. (1992) Some considerations on the dispersal power of *Digitonthophagus gazella* (Fabricius 1787) in the New World (Coleoptera Scarabaeidae Scarabaeinae). *Tropical Zoology*, 5 (1), 115–120.
https://doi.org/10.1080/03946975.1992.10539184

Baufeld, P. & Schrader, G. (2017) *Express PRA for Pentodon algerinus dispar—Interception*. Julius Kuehn-Institute, Institute for National and International Plant Health, Braunschweig, 4 pp.

Bezděk, A. (2016) Eupariini Schmidt, 1910. *In*: Löbl, I. & Löbl, D. (Eds.), *Catalogue of Palaearctic Coleoptera. Vol. 3. Revised and Updated Edition. Scarabaeoidea—Scirtoidea—Dascilloidea—Buprestoidea—Byrrhoidea*. Brill, Leiden/Boston, pp. 156–158.

Branco, T. (2011) The Eupariini (Coleoptera, Aphodiidae) of Portugal, including the first record of *Ataenius spretulus* (Haldeman, 1848) from outside North America. *Boletín de la Sociedad Entomológica Aragonesa,* 49, 145–148.

Cameron, E.K., VilaÌ, M. & Cabeza, M. (2016) Global meta-analysis of the impacts of terrestrial invertebrate invaders on species, communities and ecosystems. *Global Ecology and Biogeography*, 25, 596–606. https://doi.org/10.1111/geb.12436

Clark, S.M., Rattu, A. & Cillo, D. (2014) *Monoxia obesula* Blake, 1939, a species native to the USA and adventive to Sardinia, Italy (Coleoptera: Chrysomelidae: Galerucinae: Galerucini). *Zootaxa*, 3774 (1), 83–89. https://doi.org/10.11646/zootaxa.3774.1.6

Dechambre, R.-P. (2006) Quatre nouvelles espeÌces d'*Archophileurus* Kolbe, 1910 (Coleoptera, Dynastidae). *ColeòpteÌres*, 12, 47–53.

Denux, O. & Zagatti, P. (2010) Coleoptera families other than Cerambycidae, Curculionidae *sensu lato*, Chrysomelidae *sensu lato* and Coccinelidae. *In*: Roques, A., Marc Kenis, M., Lees, D., Lopez-Vaamonde, C., Rabitsch, W., Rasplus, J.-Y. & Roy, D. (Eds.), *Alien terrestrial arthropods of Europe. BioRisk*, 4 (1), pp. 315–406. https://doi.org/10.3897/biorisk.4.61

Di Iorio, O.R., Zubarán, G.E. & Penco, F.C. (2017) A review of the genus *Archophileurus* Kolbe, 1910 (Coleoptera: Scarabaeidae: Dynastinae: Phileurini) from Argentina and adjacent countries. *Giornale Italiano di Entomologia*, 14 (62), 549–582.

Di Iorio, O.R. (2004) Scarabaeidae. *In*: Cordo, H.A., Lograzo, G.A., Braun, K. & Di Iorio O.R. (Eds.), *Cataìlogo de Insectos fitoìfagos de la Repuìblica Argentina y sus plantas asociadas*. Sociedad Entomoloìgica Argentina, Buenos Aires, pp. 183–196.

Dymock, J.J. (1993) A case for the introduction of additional dung-burying beetles (Coleoptera: Scarabaeidae) into New Zealand. *New Zealand Journal of Agricultural Research*, 36 (1), 163–171. https://doi.org/10.1080/00288233.1993.10427498

Endrődi, S. (1977) Monographie der Dynastinae 8. Tribus: Phileurini, Amerikanische Arten I. (Coleoptera). *Folia Entomologica Hungarica*, Series Nova, 30, 7–45.

EPPO, (2019) *Popillia japonica* (POPIJA). Available from: https://gd.eppo.int/taxon/POPIJA/distribution (accessed 5 January 2020)

Folmer, O., Black, M., Hoeh, W., Lutz, R. & Vrijenhoek R. (1994) DNA primers for amplification of mitochondrial cytochrome c oxidase subunit I from diverse metazoan invertebrates. *Molecular Marine Biology and Biotechnology*, 3, 294–299.

Forbicioni, F. (2019). *Trigonorhinus zeae* (Wolfrum, 1931) new alien species introduced in Italy and continental Europe (Coleoptera Curculionoidea Anthribidae). *Revista Gaditana de Entomologia*, 10 (1), 81–87.

Forshage, M. & Krell, F.-T. (2016) Two exotic dynastines collected in Sweden (Coleoptera: Scarabaeidae: Dynastinae). *Entomologisk Tidskrift*, 137, 147–149.

Guariento, E., Colla, F. Steinwandter, M., Hava, J. & Sebber, J. (2019) First record of *Attagenus smirnovi* Zhantiev, 1973 from Italy in South Tyrol (Coleoptera Dermestidae). *Fragmenta Entomologica*, 51 (2), 251–253. https://doi.org/10.4081/fe.2019.370

Hulme, P.E. (2009) Trade, transport and trouble: managing invasive species pathways in an era of globalization. *Journal of Applied Ecology*, 46 (1), 10–18. https://doi.org/10.1111/j.1365-2664.2008.01600.x

Inghilesi, A.F., Gherardi, F., Mazza, G., Rey, A. & Stebnicka, Z. (2011) First report for Europe of *Ataenius picinus* (Coleoptera: Scarabaeidae: Aphodiinae). *Entomological News*, 122 (1), 97–99. https://doi.org/10.3157/021.122.0115

Jameson, M.L., Oishi, D.E., Ratcliffe, B.C. & McQuate, G.T. (2009) Two additional invasive scarabaeoid beetles (Coleoptera: Scarabaeidae: Dynastinae) in Hawaii. *Proceedings of the Hawaiian Entomological Society*, 41, 25–30.

Johnson, C. (1975) Nine species of Coleoptera new to Britain. *Entomologist's Monthly Magazine*, 111, 177–183.

Jucker, C. & Lupi, D. (2011) Exotic Insects in Italy: An Overview on Their Environmental Impact. *In*: Lopez Pujol, J. (Ed.), *The Importance of Biological Interactions in the Study of Biodiversity*. InTech, London, pp. 51–74. https://doi.org/10.5772/24263

Katsanevakis, S., Coll, M., Piroddi, C., Steenbeek, J., Ben Rais Lasram, F., Zenetos, A. & Cardoso A.C. (2014) Invading the Mediterranean Sea: biodiversity patterns shaped by human activities. *Frontiers in Marine Science*, 1, 32. https://doi.org/10.3389/fmars.2014.00032

Kenis, M. & Branco, M. (2010) Impact of alien terrestrial arthropods in Europe. *In*: Roques, A., Marc Kenis, M., Lees, D., Lopez-Vaamonde, C., Rabitsch, W., Rasplus, J.-Y. & Roy, D. (Eds), *Alien terrestrial arthropods of Europe. BioRisk*, 4 (1), 51–71. https://doi.org/10.3897/biorisk.4.42

Král, D. & Bezděk, A. (2016) Chironinae C.E. Blanchard, 1845. *In*: Löbl, I. & Löbl, D. (Eds.), *Catalogue of Palaearctic Coleoptera, Volume 3. Revised and Updated Edition. Scarabaeoidea—Scirtoidea—Dascilloidea—Buprestoidea—Byrrhoidea*. Brill, Leiden/Boston, pp. 166–166.

Krell, F.-T. & Bezděk, A. (2016) Dynastinae Macleay, 1819. *In*: Löbl, I. & Löbl, D. (Eds.), *Catalogue of Palaearctic Coleoptera. Vol. 3. Revised and Updated Edition. Scarabaeoidea—Scirtoidea—Dascilloidea—Buprestoidea—Byrrhoidea*. Brill, Leiden/Boston, pp. 358–367.

Kumar, S., Stecher, G., Li, M., Knyaz, C. &Tamura, K. (2018) MEGA X: molecular evolutionary genetics analysis across computing platforms. *Molecular Biology and Evolution*, 35, 1547–1549. https://doi.org/10.1093/molbev/msy096

Lemaire, J.-M. & Raffaldi, J. (2014) Un Aphodiidae exotique nouveau pour la faune franco- moneìgasque: *Ataenius picinus* Harold, 1867 (Coleoptera, Scarabaeoidea, Aphodiidae, Eupariini). *Le ColeòpteÌriste*, 17 (3), 176–178.

Leo, P., Ziani, S. & Leo, P. (2015) *Ataenius picinus* Harold, 1867, first records from Sardinia and updates on its distribution in mainland Italy. *Revista Gaditana de Entomología*, 6 (1), 113–118.

Liebhold, A.M. & Tobin, P.C. (2008) Population ecology of insect invasions and their management. *Annual Review Entomology*, 53, 387–408.
https://doi.org/10.1146/annurev.ento.52.110405.091401

Massaro, R. (2010) Trigo: lo que hay que "descubrir" antes de sembrar. Available from: https://inta.gob.ar/sites/default/files/script-tmp-lo_que_hay_que_descubrir.pdf. (accessed 30 August 2019)

Mazza, G., Pennacchio, F., Marianelli, L., Rey, A., Dellacasa, M., Dellacasa, G., Stasolla, G., Tricarico, E., Inghilesi, A.F. & Roversi, P.F. (2014) First interception of *Acrossidius tasmaniae* (Hope, 1847) in Europe. *Redia*, 97, 113–115.

Meissner, H., Lemay, A., Bertone, C., Schwartzburg, K., Ferguson, L. & Newton, L. (2009) *Evaluation of pathways for exotic plant pest movement into and within the greater Caribbean Region*. Caribbean Invasive Species Working Group, USDA APHIS Center for Plant Health Science and Technology, Raleigh, North Carolina, 274 pp.

Mola, L. & Yoshida, T. (2019) *Psammoecus trimaculatus* Motschulsky, 1858, new to the Italian fauna (Cucujoidea: Silvanidae). *Fragmenta Entomologica*, 51 (1), 47–50.
https://doi.org/10.4081/fe.2019.341

Mondaca, J. (2011) Primer registro de *Cyclocephala modesta* (Scarabaeidae: Dynastinae: Cyclocephalini) en Chile. *Revista Chilena de Entomologia*, 36, 33–38.

Moron, M.A. (2009) Cheafers, rhinoceros and fruit beetles of the canopy of tropical forests. *In*: Del Claro, K., Oliveira, P.S. & Rico-Gray, V. (Eds.), *Tropical biology and conservation management. Vol. VII. Encyclopedia of life support systems*. Eoloss Publishers, Oxford, pp. 34–63.

Paulian, R. & Baraud, J. (1982) *Lucanoidea et Scarabaeoidea, Faune des Coléoptères de France, Vol. II. Encyclopédie Entomologique XLIII*. Lechevalier, Paris, 473 pp.

Poland, T.M. & Rassati, D. (2019) Improved biosecurity surveillance of non-native forest insects: a review of current methods. *Journal of Pest Science*, 92 (1), 37–49.
https://doi.org/10.1007/s10340-018-1004-y

Pyšek, P. & Richardson D.M. (2010) *Invasive Species*, *Environmental Change and Management, and Health*. *Annual Review of Environment and Resources*, 35, 25–55.
https://doi.org/10.1146/annurev-environ-033009-095548

Rakovič, M., Král, D. & Bezděk, A. (2016) Psammodiini Mulsant, 1942. *In*: Löbl, I. & Löbl, D. (Eds.), *Catalogue of Palaearctic Coleoptera, Volume 3. Revised and Updated Edition. Scarabaeoidea—Scirtoidea—Dascilloidea—Buprestoidea—Byrrhoidea*. Brill, Leiden/Boston, pp. 158–165.

Ratti, E. (2007a) Coleotteri alieni in Italia/Alien Coleoptera in Italy. Version 25 May 2007. Available from: http://www.msn.visitmuve.it (accessed 5 January 2020)

Ratti, E. (2007b) Elenco dei Coleotteri riscontrati nelle aree urbane di Venezia/*List of Coleoptera found in urban habitats of Venice, Italy*. Museo di Storia Naturale di Venezia, Venice, 52 pp. Available from: http://www.msn.ve.it/index.php?pagina=progamb_view&id=7&idprog=32 (accessed 10 February 2020)

Ritcher, P.O. (1966) *White Grubs and their Allies. A study of North American Scarabaeoid Larvae. Monograph Series No. 4*. Oregon State University Press, Corvallis, Oregon, 219 pp.

Ruzzier, E. & Colla, A. (2019) *Micromalthus debilis* LeConte, 1878 (Coleoptera: Micromalthidae), an American wood-boring beetle new to Italy. *Zootaxa*, 4623 (3), 589–594.
https://doi.org/10.11646/zootaxa.4623.3.12

Salvato, G. & Uliana, M. (2016) Prime segnalazioni di *Cortodere (Aridius) bifasciata* (Reitter, 1877) in Italia (Insecta, Coleoptera, Latridiidae). *Natura Bresciana, Annali del Museo Civico di Scienze Naturali di Brescia*, 40, 145–145.

Sanmartín, I. & Martín-Piera, F. (2003) First phylogenetic analysis of the subfamily Pachydeminae (Coleoptera, Scarabaeoidea, Melolonthidae): the Palearctic Pachydeminae. *Journal of Zoological Systematics and Evolutionary Research,* 41, 2–46.
https://doi.org/10.1046/j.1439-0469.2003.00179.x

Toma, L., Yus Ramos, R. Severini, F. Di Luca, M., Mei, M. & Zampetti, M.F. (2017) First record of *Bruchidius raddianae* in Italy: infested seeds of *Vachellia karroo* from Lampedusa island (Coleoptera: Bruchidae; Fabales: Fabaceae). *Fragmenta Entomologica*, 49 (1), 89–91.
https://doi.org/10.4081/fe.2017.236

Vanin, S.A., Costa, C. & Fontes, L.R. (1983) Larvae of Neotropical Coleoptera. VI Scarabaeidae, Dynastinae, Phileurini. *Papéis Avulsos de Zoologia,* 35, 55–72.

Urban, P. (2018) Ein Fund des Japankäfers *Popillia japonica* (Newman, 1841) (Coleoptera, Scarabaeidae, Rutelinae) bei Paderborn-Sennelager (Nordrhein-Westfalen)—erster Nachweis der Art in Deutschland bzw. Mitteleuropa. *Mitteilungen der Arbeitsgemeinschaft Westfälischer Entomologen*, 34 (1), 21–24.

Urban, P., Schulze, W. & Zorn, C. (2019) Ein Fund des Japankäfers *Popillia japonica* Newman, 1838 in Bayern mit Anmerkungen zum Auftreten in Europa (Coleoptera: Scarabaeidae: Rutelinae). *Nachrichtenblatt der Bayerischen Entomologen*, 68 (3/4), 117–119.

Zappi, I. (2014) Prima segnalazione per l'Italia di *Tarsostenus carus* (Coleoptera Cleridae). *Bollettino della Società Entomologica Italiana*, 146 (1), 3–5.
https://doi.org/10.4081/BollettinoSEI.2014.3